

Notes on species of *Hyptis* Jacq. (Lamiaceae) naturalised in the Northern Territory, Australia

Philip Short¹ and Kathy De La Rue²

¹ Northern Territory Herbarium, PO Box 496,
Palmerston NT 0831, Australia. Email: Philip.Short@nt.gov.au

² 11 Bedwell Crt, Gray NT 0830, Australia.

Abstract

Weeds are present in all but the most pristine of environments. For anyone wishing to know when species were introduced to a region, and how quickly they have spread, the best records frequently come from herbarium specimens. Indeed, specimens provide the best means of tracking the spread of a species because their identity can be checked. Providing the species in question is readily identifiable, written records, and sometimes verbal records, can also be used with confidence. We use herbarium specimen data and written records to document the time of introduction and establishment of all three species of *Hyptis* now recorded for the Northern Territory. We also comment on some of their weedy attributes and outline early attempts to eradicate *H. suaveolens* from Darwin.

Introduction

Established weeds commonly have several attributes which help ensure their success, viz. annual life-cycle, rapid growth rate, self-pollination, self-fertilisation, non-specialised pollinators, asexual reproduction, numerous seed, good seed dispersal, long-lived seed bank, non-specialised habitat requirements, and secondary chemicals which protect them from pathogens and make them unpalatable to most insects and other herbivores.

As with so many members of the family Lamiaceae – which includes basil, lavender, rosemary, sage and thyme – species of *Hyptis* are aromatic and both *H. capitata* and *H. suaveolens* carry highly aromatic oils which make them unpalatable to stock. All three produce seed (technically single-seeded fruit referred to as nutlets or mericarps) which are readily dispersed; the seed often remains within the calyx segments which readily adhere to fur, wool and other fibrous material. Seed can also be dispersed by water, and in mud on shoes, animal fur and hooves, and vehicles. At least in the case of *H. suaveolens* the pericarp – the outer layer of the nutlet – becomes gelatinous when wet, and nutlets can adhere to both animals and vehicles. Vehicles driven through stands of fruiting plants will dislodge nutlets from the calyx, and on early mornings when damp from dew, swollen and sticky nutlets are commonly found adhering to vehicles (I. Cowie, pers. comm.).

An interesting aspect of the seeds of *H. capitata* and *H. suaveolens* is that they require exposure to light to germinate. Light filtering through an upper canopy of leaves is predominantly far-red radiation, a wavelength that inhibits germination, thus explaining why plants are common in exposed, disturbed areas of woodland and pasture but not in rainforest (e.g. Wulff & Medina 1971; Parsons & Cuthbertson 2001).

Two of the three species discussed here, *H. capitata* and *H. suaveolens*, are Declared Weeds in the Northern Territory (NT), both falling in schedule classes B and C under the *Weed Management Act 2001* (see Miller 2003 for a summation of the *Act*). For class B weeds, attempts should be made to control their growth and spread, while for class C weeds they should not be introduced into the NT. Only class A weeds have to be eradicated.

Key to species

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|----|---|-----|-----|----------------------|
| 1 | Flowers in loose, 2 to 5-flowered groups (cymes) | ... | ... | <i>H. suaveolens</i> |
| 1: | Flowers in globular clusters or dense spikes | ... | ... | ... |
| 2 | Flowers white, in solitary globular clusters 8-10 mm diam. at flowering | ... | ... | <i>H. capitata</i> |
| 2: | Flowers light blue, violet or purplish, in head-like or spike-like clusters | ... | ... | ... |
| | 10-15 mm long at flowering | ... | ... | <i>H. spicigera</i> |

Species accounts

Hyptis capitata Jacq.

A perennial herb or undershrub commonly known as Knobweed because of its globular heads of white flowers (Figure 1), this species is a native to Central America but is now a widespread weed in most of the tropical world. In Australia, it was first recorded along the South Johnstone River near Innisfail, Queensland in 1937. Parsons and Cuthbertson (2001) indicated that it was possibly introduced to this region as a contaminant of agricultural seed. It is now an established weed in coastal areas of northern and south-eastern Queensland and in the Top End of the NT (e.g. Parsons & Cuthbertson 2001; Navie 2004; Smith 2002). The species is particularly unpalatable to stock, seeds prolifically and has large reserves in the rootstock allowing it to resprout quickly and out-compete surrounding species (Parsons & Cuthbertson 2001).

Flanagan (1998) recorded that the only population in the NT was at Kakadu National Park, and that it was subject to an eradication program. Although a more precise locality was not stated, it is here assumed that the population referred to was on the margins of the park at Ben Bunga Jungle – examination of specimens at the Northern Territory Herbarium (DNA) revealed that it was first collected from that locality in May 1992 (*Russell-Smith 8809*). Plants were growing in black soil on the moist edge of the jungle. Since that time, herbarium specimens have again been collected from Ben Bunga Jungle, one gathered in 1996 (*Harwood 155*), the most recent in 2000

(McSkimming 65706 & Mitchell). There are no further herbarium records, but there is a report that attempts to control the species in Kakadu National Park were on-going in 2007/08 (Anonymous 2008). Patrick Shaughnessy (pers. comm.) has advised us that Knobweed is still only found in the Ben Bunga area and that only about 40 plants remain, albeit scattered over a large area.

Figure 1 (right).
Hyptis capitata at
Merauke, Irian Jaya.
(Colin Wilson)



Figure 2
(below left).
Hyptis suaveolens
in flower.
(Ben Stuckey)

Figure 3
(below right).
Hyptis suaveolens
in flower and fruit.
(Ian Cowie)



Hyptis spicigera Lam.

An annual, aromatic herb growing to about two metres tall and with purplish, light blue or violet flowers arranged in dense spikes, this species is native to tropical America, but is now widely naturalised in various tropical countries in Africa and Asia and on many Pacific islands. Of the known non-Australian localities the nearest is possibly Timor. As with many weeds *H. spicigera* is found in an array of habitats. In Malesia, it has been recorded, sometimes in abundance, from waste places, wet rice-paddies, open grasslands and coastal coral limestone (Keng 1978). The plants are used by many people. For example, leaves can be eaten as a vegetable, seeds are eaten and used for oil production, plants may be burnt and used as a mosquito repellent and, in parts of Africa, plants and their seed are stored with Cowpeas, the insecticidal properties of *H. spicigera* protecting the Cowpeas from weevil (e.g. Anonymous, undated; Sanon *et al.* 2006).

The first herbarium record of *H. spicigera* in Australia is D.E. Symon 7758, a duplicate specimen of which is housed in the Northern Territory Herbarium (DNA), the original being in the State Herbarium of South Australia (AD). The specimen was collected in June 1972 and its location is recorded as 23 miles (c. 40 km) south-west of the Cape Caledon turn-off in Arnhem Land. No other locality or habitat notes accompany the specimen. Since then, further specimens have been collected on several occasions, all gathered within c. 100 km of Nhulunbuy. In September 1998 the species was recorded as being “extensive on paddock boundaries and roadside [in] open grassland area” on Garathea Cattle Property, about 70 km south-west of Nhulunbuy (N.S. Smith 4384). In April 2001 it was noted to be abundant in a “cattle paddock near Bulbultbuy on Nhulunbuy to Bulman Rd ... [and] eaten by the cattle” (A.A. Mitchell 6725); this location is approximately the same as for the former collection. In the same month it was also collected from a slope behind the beach at the Yuduyudu Community about 17 km from Nhulunbuy (A.A. Mitchell 6757). It is clearly naturalised.

We are unaware of any documentation of how the species came to be established in eastern Arnhem Land.

Hyptis suaveolens (L.) Poit.

In the literature, the common name generally applied to this species is simply Hyptis (e.g. Parsons & Cuthbertson 2001; Navie 2004). The name Horehound, more usually applied to *Marrubium vulgare* L., has also been applied to this species (e.g. Miller & Schultz 2002), as has the name Schmidt’s (or Schmid’s) Folly.

Native to tropical America, *H. suaveolens* is now a widely dispersed weed found from Africa east to Australia, Papua New Guinea and the Pacific islands (Parsons & Cuthbertson 2001). Plants are stiffly erect, mostly annual herbs which in good conditions can be approximately three metres tall but more commonly reach about 1-1.5 m in height (Figures 2, 3). Their smallish, bluish purple flowers occur in loose

clusters in the axils of the upper leaves and, on ripening, seeds remain within the bristly calyx segments. In the Top End, seed mostly germinates after the opening rains at the end of the dry season, and plants commonly flower from about February to May. Plants usually die during the dry season, but those in well-watered areas may persist to the following year.

The easy transport of seed, by its adherence to hair and in mud, has already been mentioned and is undoubtedly an important means of spread within our rangelands. However, Parsons and Cuthbertson (2001) recorded that its spread in pastures in the Top End has primarily been as a contaminant of hay and, perhaps, pasture seed. We are unaware of any figures relating to the level of seed set in NT plants, but in what we assume to be a figure determined from a dense, healthy stand of plants in India, Raizada (2006) recorded that more than 2,000 seeds are produced per square metre. It is not an abnormally high figure for either a weed or a non-weed species (e.g. Hill 1977, table 5), but no doubt such levels have contributed to the spread of *Hyptis*.

The medical uses of *H. suaveolens* are widely documented, not just in its tropical American homeland but also in India and other countries where it is naturalised. Prior to British settlement of the Top End it appears that it was already in use as a treatment of respiratory and gastrointestinal infections, parasitic skin diseases, and other ailments such as colds and fever (e.g. Parrotta 2001; Moreira *et al.* 2010). The effectiveness of the antibacterial and antifungal activities of its essential oils have also attracted the attention of research workers (e.g. Mandal *et al.* 2007; Moreira *et al.* 2010).

As discussed later, the natural chemical properties of this species limited the number of potential biocontrol agents to be found in its native habitat. It is therefore no surprise that *Hyptis* is, and has been, used as an insect repellent in many parts of the world. In West Africa fresh or smouldering plant material of *Hyptis* has been used as a repellent for adult mosquitoes and, as with *H. spiciqera*, leaves are used to protect stored Cowpeas from insect attack (Pålsson & Jaenson 1999; Sanon *et al.* 2006). In both the Philippines and Timor it is reported that branches are placed under beds and chairs as a deterrent to bed bugs. In the Darwin region, we know of at least one person who, to deter lice and ticks, places pieces of *Hyptis* leaves in the egg-laying boxes of free-range fowls.

The chemical properties of *H. suaveolens* also make it unpalatable to many Australian insects. Colin Wilson (1997) recorded only six species feeding on wild populations of *Hyptis* in the NT. In contrast, two other common weeds, Spinyhead *Sida* *Sida acuta* Burm.f and Flannel Weed *S. cordifolia* L., neither of which have obvious insecticidal properties but have a similar geographical range to *Hyptis*, host 20 and 23 species of plant-feeding insects respectively (Wilson & Flanagan 1990).

Unsurprisingly, *H. suaveolens* has a number of the attributes of successful weeds; its vigorous growth, readily dispersed seed and insect-repelling properties have already been mentioned. Plants are also capable of self-fertilisation and do not have a

specialist pollinator (e.g. Raizada 2006). Another attribute helping to ensure its success is the considerable variation in seed size within populations. Differences in size are correlated with variation in germination response to different light and temperature regimes and to the early size and performance of seedlings (Wulff 1973). Such variation may well enable the species to exploit different ecological niches and better compete against other species (Harper *et al.* 1970; Wulff 1973).

History of *H. suaveolens* in the Northern Territory

The earliest record of *H. suaveolens* in Australia is of a collection made by Ludwig Leichhardt. Bentham (1870, p. 80) cited a specimen "Garden Bay, Port Essington, *Leichhardt*. A common tropical American weed now found in many parts of the Old World, and probably introduced into Australia from the Indian Archipelago." From Bentham's statement and from knowledge of Leichhardt's movements (Webster 1986) it can be safely concluded that *H. suaveolens* is not native, but was growing at Port Essington at least as early as 1845, and that it was a deliberate or accidental addition to the settlement's garden. The source of the seed is less certain. It may have come from tropical America as it is known that John Armstrong, the gardener and botanical collector at Port Essington, soon after the settlement's founding in October 1838, sowed a garden with seeds and plants brought from Rio de Janeiro and Sydney (Spillett 1972). On the other hand, Bentham's suggestion that *Hyptis* was introduced from somewhere in Indonesia is also consistent with the recorded knowledge of the activities of Armstrong. In November 1838, camp supplies were obtained from the island of Kissa [Kisar] and these included "a variety of seeds" (Spillett 1972, p. 32). Furthermore, in February-March the following year, Armstrong selected suitable plants for cultivation during visits to Dilli [Dili], Kissa [Kisar], Moa and Coepang [Kupang]. Calley (1998) has also suggested *Hyptis* may have been introduced to Port Essington as a contaminant of fodder from Timor. It may also have entered via a number of other vessels, involved in trading and exploration, which had visited Port Essington before Leichhardt's arrival in December 1845.

Reporting on the establishment of *H. suaveolens*, Maurice Holtze, the first Director of the Botanic Gardens in Darwin recorded that it "was found by Leichhardt at Port Essington, and is [still] found within a limited radius of the old settlement" (Holtze 1892, p. 1). He further stated that *H. suaveolens* had also been introduced to the Top End on another occasion, this time at "Port Darwin, where it was introduced about 20 years ago by a Mr. Schmidt, from Timor, [and where] I have been able to watch its spread in the wake of settlement". He also noted that both it and *Passiflora foetida* L. were "exterminating the native vegetation wherever they have taken root, by their almost incredible luxuriance" (Holtze 1892, pp. 1-2).

Holtze was not the only person to observe the spread of *H. suaveolens*. One of us (KDLR, unpublished) has documented references to the weed in Palmerston – as Darwin was then known – in 16 editions of the *Northern Territory Times and Gazette*

from 1876 to 1880. Reports covered the introduction of the weed, and attempts to exterminate it, and included comments by the editor and the general public and minutes from meetings of the Palmerston Town Council. The first report, on 1st April 1876, confirmed the origin of the common name and reported a lack of funding – or desire? – to control the weed:

Mr Schmid visited Timor some years ago and brought back various seeds including a few of the beautiful and luxuriant horehound weed, now called in the Territory "Schmid's' Folly" this season it has overrun nearly the whole of the township. A deputation of the Palmerston District Council waited on the Govt Resident [GR] to ask assistance in destroying it. The GR said the government would not do it but would hire coolies to the Council at 1/- [one shilling] per head per diem for the purpose. Council is short of funds and could not accept the offer. Council could employ one white man to supervise a gang of natives who might easily be paid out of the £250 voted for their use, the expenditure of which is at present a mystery.

In a subsequent report, dated 24 February 1877, it was recorded that council had declined an offer by the Government Resident of prison labour, at "3/6 per man per day to destroy horehound weed." A month later the following appeared:

The horehound weed will soon obliterate all traces of vegetation but its own in the town. On some of the unoccupied allotments it has taken thorough possession, it being impossible to pass over them through the density of the weed. In a short time if it is not eradicated, it will overrun the whole country and prove as great a curse to the NT as the (so-called) Scotch thistle and Bathurst burr have proved to the southern colonies. We were please [sic] to observe that Mr George Parker who has bought the Exchange Hotel Smith Street, is making an effort to destroy it in that neighbourhood. With 3 natives, two paid by the government and one employed by himself, he is clearing some allotments in his neighbourhood, many not belonging to himself...

The desirability to attempt to eradicate the weed was again expressed on 7 April 1877 although, just two weeks later, a correspondent expressed happiness that nothing had been done to "destroy that beautiful Herbage Plant Horehound called Schmidt's folly." However, an article on the 5th of May read:

We are glad to see that the side of the hill adjoining the road to the Camp has been cleared of horehound weed and presents a much more pleasing appearance as well as smell. The gentlemen at present luxuriating in gaol have been engaged on the work, and we think it would be a good thing if the District Council were to follow the example set them by clearing away other places. ...

This was followed by a note on 6 April 1878 recording that "A party of natives are clearing the horehound. It is to be hoped they will clear it beyond the Wesleyan Church to Cavenagh Street" and on 27 April 1878 "Palmerston District Council

should more closely supervise the natives removing horehound. Young plants are being left to go to seed."

More reports followed, but in essence they document the clearance of plants from the township, the Council and others now being anxious to get rid of *Hyptis* which was growing along the streets and clogging roadside gutters. Unfortunately, due to the aforementioned failure to remove all plants, clearance was only temporary. However, it was a concerted effort to eradicate plants, as shown in the following excerpt of 14 February 1880:

At the meeting of the Council on Tuesday last ... Resolved that a bye law be drafted for confirmation compelling owners or occupiers of property to draw and destroy all horehound weed on their respective allotments, otherwise same to be done by Council at owner's or occupier's expense.

Unfortunately *Hyptis suaveolens* was not exterminated and it is now found throughout much of northern NT, being widespread in the Darwin, Katherine, Gulf and Victoria River districts, and with an isolated infestation at Barrow Creek (Miller & Schultz 2002). It is also found throughout much of northern Western Australia and northern Queensland.

Hyptis was the first weed in the NT to be targeted for aerial spraying, a population on Beatrice Hill being sprayed in 1970 (Miller 2004). As well as aerial spraying, potential biological control agents have also been obtained and tested for release. A number of publications refer to this research, including Parsons and Cuthbertson (1992), C.G. Wilson (1997), A. Wilson (2001), Kissinger (2003) and Auld (2009), but the most informative is Julien (2002), in which it is noted that CSIRO Entomology began searching for potential agents in Brazil. Major surveys were conducted in 1979 and 1982, while smaller surveys in Mexico and Venezuela occurred in 1981. During this work it was noted that there is considerable morphological variation within *H. suaveolens* and that the plant's natural chemical protection limits the suite of potential agents available for testing. More were discovered during 2000-2002 following further work in Mexico and Venezuela; these included flower-feeding beetles, leaf- and stem-feeding weevils, and assorted moths.

Mic Julien (pers. comm.) has indicated that the program, originally initiated by CSIRO on behalf of the NT Government, ceased after 2002. Julien *et al.* (in press) discuss in some detail the various agents tested and the problems encountered in the search for suitable control agents for *Hyptis*. To date, nothing suitable has been found, but the authors indicate that some potential agents warrant further testing.

Just why *Hyptis* was introduced to Darwin and Port Essington does not appear to have been stated in any early documentation. It may have been deliberate because it was considered to be an attractive addition to the garden. However, medicinal and insecticidal properties of *Hyptis* may also explain its introduction. The use of herbs

for medicinal purposes and as insect repellents is a practice many hundreds of years old and, as previously outlined, there is a history of Hyptis being put to such use.

Finally, we note that the referee of this article drew our attention to anecdotal reports that Hyptis was drunk as a tea or tonic by early Chinese residents of Darwin, and that the Chinese may have been responsible for its introduction. Although anecdotal, these reports support the notion that the introduction of Hyptis to Darwin, and perhaps also Port Essington, was deliberate. However, any belief that the Chinese brought Hyptis to Darwin is not supported by published records. The Chinese did not settle in the NT until August 1874 (De La Rue 2004) and in the report of 1st April 1876 in the *Northern Territory Times and Gazette* it was specifically stated that Hyptis was introduced "some years ago" by Schmid.

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Hyptis Hyptis suaveolens is an abundant weed in the Top End of the Northern Territory. (Deb Bisa)